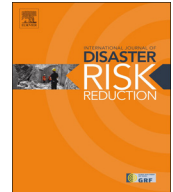




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## Review Article

## Human stampedes during religious festivals: A comparative review of mass gathering emergencies in India

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## ABSTRACT

Human stampedes have been identified as a major hazard that could occur during mass gathering events in India, as well as anywhere in the world where people crowd together. This study compiles and analyses stampede data from religious, entertainment and political gatherings over the last five decades in India to derive an effective risk reduction framework for mass gatherings. Religious gatherings and pilgrimages have been venues for 79% of the stampedes in India. Noticeable occurrences and casualties have been reported from 15 Indian states and there have been instances of recurrent stampedes at certain locations. Risk management strategies to tackle stampedes during religious festivals are quite inadequate and have failed consistently in India because of the large crowds and the constantly widening spread of the venue. The triggers of human stampedes have been identified from case studies and it is concluded that a simple accident, an intentional act or even a rumor can trigger a crowd disturbance. Hence the organizers have to take into consideration the causes of crowd disturbance for ensuring safety in mass gatherings. The vulnerability of religious gatherings is also increased due to venue inadequacies like remote or hazard-prone setting, poor facilities, or lack of basic infrastructure and medical care centers. The risk factors identified from the study of past incidents have led to the development of a basic framework aligned on four interlinked compartments for inter-agency cooperation and multi-disciplinary contemplation ranging from hazard identification to the execution of mitigation measures for human stampede risk reduction.

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## Contents

1. Introduction . . . . .	11
1.1. Human stampedes in literature . . . . .	11
2. Methodology . . . . .	11
3. Profile of mass gatherings in India . . . . .	12
4. Results and discussion . . . . .	12

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4.1. Human stampedes—event based analysis . . . . .	12
4.2. Crowd disturbance in a stampede . . . . .	14
4.3. Safety in religious gatherings . . . . .	14
4.4. Stampede risk reduction in mass gatherings . . . . .	15
5. Conclusions . . . . .	17
References . . . . .	17

## 1. Introduction

The increasing population of India [1] and the tendency of people to gather for a common objective or interest makes events, especially religious ones, an increasingly crowded one. A crowd is made up by the clustering of spectators and participants, but in religious congregations the crowd is mostly made up of participants (the devotees). There are exceptions to this, certain practices associated with religious festivals involve the assembly of crowds specifically attracted to fireworks and similar pyrotechnic displays. Federal Emergency Management Agency of the United States [2] considers special events and mass gatherings as 'a non-routine activity within a community that brings together a large number of people'. Mass gatherings of persons have been defined by the World Health Organization [3] as 'more than a specified number of persons at a specific location for a specific purpose for a defined period of time'. The latter definition brings in the aspect of time. Mass gathering is often explained from the perspective of emergency medicine as an organized event in defined temporary facilities or open space involving the gathering of participants and spectators during which an emergency response of the community, state or nation may be delayed by virtue of limited access or other challenges [4–8]. Approximate crowd size estimated by researchers to designate an event as mass gathering is > 25,000 individuals [3], > 5000 individuals [9], and > 1000 individuals [3,5] for a period of more than 24 h [9]. Forsyth [10] has suggested that a social relationship exists between the individuals in a group and this binds them, however disparate they may individually be. Large crowds create annoyances and difficulties to a section of the society, leading to severe traffic delays, increased crime, pollution, epidemics, alteration in landscape, haphazard development of the area etc. [11] and ultimately become the source of medical emergencies and disasters. Multiple deaths and injuries at mass gatherings have occurred consistently, over a wide spectrum of events and countries [12]. Human stampedes, the most common hazard prevailing in mass gathering events, are characterized by the surge of individuals in a crowd, in response to a perceived danger or loss of physical space. It often disrupts the orderly movement of crowds resulting in irrational and dangerous movement for self-protection leading to injuries and fatalities. Human stampedes are influenced by a number of factors related to the biomedical, environmental and psychological domains [13]. Procedures of mass casualty management and medical care aspects of mass gatherings have been well researched especially in the developed world [5,13–16]. People die in stampedes mostly due to suffocation under the high pressure (of up to 4500 N/m) on their chests generated by the push of the crowd [17].

However, hazards at mass gatherings have not been studied on a priority basis within the framework of disaster risk management to conceptualize effective planning, preparedness and response and hence limited literature is available in that perspective. In order to reflect the behavior of pedestrian flow, Helbing and Molnar [18] brought forward the social force model which can simulate crowd movement and demonstrate the movement of the panicked crowd in the evacuation process. It is now widely accepted that crowd behavior is in turn influenced and generated by its smallest unit, viz., the individual and it is independent of the situation and is a social and dynamic phenomenon [19].

### 1.1. Human stampedes in literature

Soomaroo and Murray [20] compiled incidents of mass gathering disasters for the period between 1971 and 2011 through a search of peer reviewed publications and gray literature. Hsieh et al. [21] reviewed human stampede events from 1980 to 2007 and found that 215 stampedes had been reported worldwide with 7069 deaths and more than 14,000 injuries. Developing countries are more vulnerable to stampedes during mass gathering events, with an eight-fold higher fatality rate than in the rest of the world [22]. The deadliest three human stampedes in the world over the past century include the stampede in Baghdad during a religious procession in 2005 (965 fatalities), Mina Valley during the annual Hajj in 2006 (380 fatalities) and Phnom Penh black Friday shopping stampede in 2010 at Cambodia with 347 fatalities [23]. Pradeepkumar et al. [24] have also looked into the epidemiology of stampedes at the religious congregation at Sabarimala, in the south Indian state of Kerala, where in a span of a few weeks, devotees from all over India numbering more than the total population of the state congregate. One hundred and nine deaths occurred in the stampede at the close of the festival season here in 2011. Few scientific studies have looked into the sociological and religious aspects of this pilgrimage. Guilamoto et al. [25] has studied the itineraries of the pilgrims.

## 2. Methodology

The objective of this study is to understand mass gatherings and resultant human stampedes in India with a view to derive a disaster risk reduction framework for mass gathering events. Mass gathering events were identified from the news papers, online reports and peer-reviewed literature and the information thus culled was then used to sketch the chronology of incidents with date of occurrence, time, geography, type of event, location,

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